STEM at the Met Office – from Science Camps to Green Man

Description

Summer is a busy time for the Met Office's award-winning outreach programme, with activities designed to encourage young people to engage with science, technology, engineering and mathematics (STEM) taking place across the UK. During 2016 there have been more activities than ever – we held five Science Camps, ran an interactive sand sculpture workshop, attended the Big Bang Fair South West and spent four days at the Green Man festival in Wales, to mention just a few. Here's a brief summary of what we've been up to.

At the end of June, we attended The Big Bang Fair South West, an event which attracted around 2000 young people from all backgrounds. The Met Office's stand was a popular as ever, with hands-on activities including expanding marshmallows showing the effect of lowering atmospheric pressure; roll-a penny storm tracks illustrating uncertainty within weather forecasts and a roulette wheel customised to help students get to grips with climate projections.

The Met Office exhibit at the Big Bang Fair South West

At the start of August, Met Office volunteers took to Teignmouth beach to run Sandscape, an interactive sand sculpture workshop exploring how weather and climate affect our health. This was delivered as part of T.R.A.I.L (Teignmouth Recycled Art in the Landscape), the annual, internationally-renowned sculpture festival. Each day children and adults alike got the chance to learn sand sculpting skills and help evolve the sand landscape, whilst at the same time chat to Met Office scientists. At the finale of each workshop, bubbles and dry ice were used to explore topics such as air quality forecasting and urban meteorology.

Mark McCarthy, Manager of the National Climate Information Centre explained: “I had great fun working on Sandscape. Not only did I have some really interesting discussions with a wide range of participants, but it also made me stop and think about some of the important science we do outside my own area of expertise.”

Met Office volunteers running Sandscape on Teignmouth beach

Later in August we took our outreach to the Green Man, the annual music and arts festival held in the Brecon Beacons in Wales. The Met Office STEM team has been a firm favourite at the festival for the last four years, with a stall in Einstein's Garden, an area of the festival dedicated to nurturing curiosity, science and nature. For 2016, the theme of Einstein's Garden was complexity, so we designed activities tackling chaos theory and probabilistic forecasting. Amongst a variety of hands-on activities, a new addition to the stall was making origami butterflies while exploring the butterfly effect – the principle that small changes, like the flap of butterfly wings, can have big effects. Unfortunately the wind and rain we experienced over the weekend meant that only a few butterflies decorated our washing line, but the rest of our activities are weather-proof and always very popular. One visitor to our stall exclaimed 'This is kind of like a science lesson, but fun!'

Talking chaos theory at the Green Man

The Met Office's Science Camps were back as well. Due to the popularity of these events, this year there were five camps, one more than previous years, attended by 252 children from 18 different schools and one Scout Group. They spent a night camping at our headquarters in Exeter, whilst learning all about weather and climate science, and what we do here at the Met Office. As always the feedback from our young guests was incredibly positive. One keen learner said: "The Science Camp was brilliant. I have loved every activity… Thank you for the best time." Another added: "I have really enjoyed my experience. It has made me feel like I could work here when I'm older."

Understanding wind and how to measure it at a Science Camp

These are just a few of the STEM activities that we have been involved in over the summer months, and we will continue to help inspire people with further events planned, including participation in the Manchester Science Festival in October. If you want any information about any of our STEM activities you can get in touch by email.

Date Created
September 2016

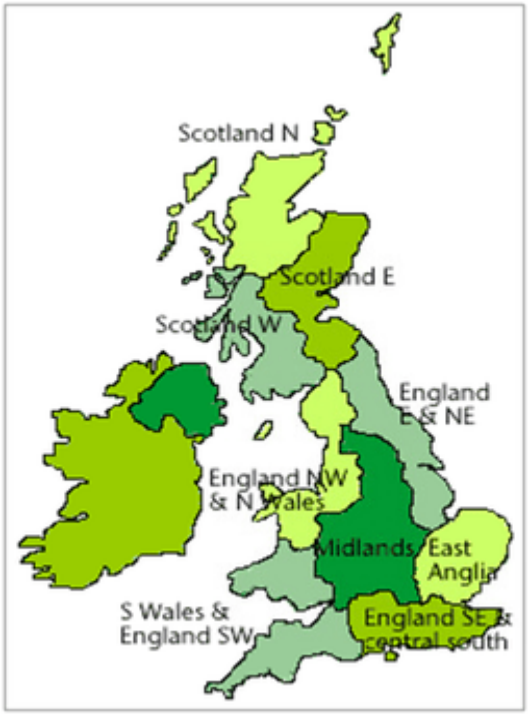
Innovative Met Office science helps new Flood Resilience Review

Description

Following last winter's flooding events the Government asked the Met Office to estimate the potential for record-breaking rainfall in the UK over the next 10 years. This work was part of the National Flood Resilience Review (NFRR).

The Met Office used an innovative approach which combined our expertise in both weather and climate science to estimate the scale of how much worse the next record breaking rainfall event is likely to be.

Using a new approach we assessed modelled weather patterns from our state of the art climate model, which generated over 11,000 monthly rainfall scenarios for 6 large regions covering England and Wales



Climate regions across the UK. For the NFRR work, only regions in England and Wales were used.

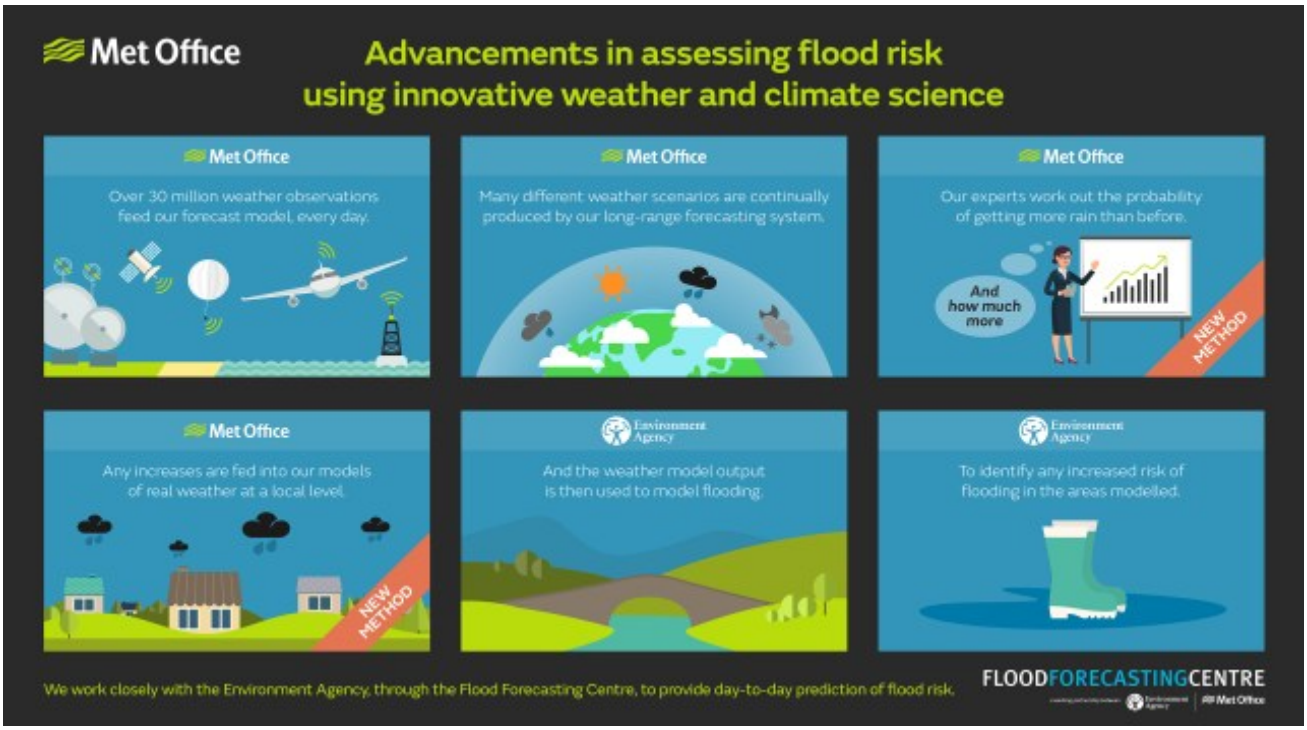
This data included several hundred extreme rainfall events, which are meteorologically possible, but lie outside what has been experienced since our observational records began. From this data, the probability of extreme events like these was then estimated.

The results suggest there is a 1% probability in any winter of experiencing 15-35% more monthly rainfall than has been seen in the observations to date. Winter monthly rainfall totals could plausibly be 20% higher than recent past extremes in some parts of the country and in other areas up to 30%

higher than recent past extremes. There is also around a 10% chance in any given year of existing monthly rainfall records, over any of the large regions, being matched or broken.

Stress Testing Flood Models

In order to translate these possible increases in regional rainfall into flood risk, we worked closely with the Environment Agency to identify large-scale river flooding events. These focused primarily on recent extreme flooding, so that any impact of climate change to date was accounted for. We also considered the effect which extreme river flooding, combined with an extreme tidal storm surge, would have.


Met Office
Advancements in assessing flood risk using innovative weather and climate science
Met Office
Over 30 million weather observations feed our forecast model, every day.
Met Office
Many different weather scenarios are continually produced by our long-range forecasting system.
Met Office
Our experts work out the probability of getting more rain than before.
And how much more
NEW METHOD
Met Office
Any increases are fed into our models of real weather at a local level.
NEW METHOD
Environment Agency
And the weather model output is then used to model flooding.
Environment Agency
To identify any increased risk of flooding in the areas modelled.
We work closely with the Environment Agency, through the Flood Forecasting Centre, to provide day-to-day prediction of flood risk.
FLOODFORECASTINGCENTRE
An infographic summarising recent advancements in assessing flood risk using innovative weather and climate science.

Detailed rainfall accumulations are important for estimating hydrological response, but are very hard to measure: rain gauges only provide spot measurements and radar can have difficulty estimating some types of rainfall. However rainfall estimates produced by the Met Office UK kilometre-scale weather forecast model provided rainfall data on fine time (every 15 minutes) and space (every 2 km) scales for each of the case studies.

The rainfall data for each test case were increased by a certain percentage in order to simulate a plausible extreme case. We combined the evidence from the climate model, with expert judgement drawn from our understanding of model limitations and a detailed analysis of past rainfall records, to estimate rainfall increase for each case study. These ranged from 20% for North-West England to 30% for cases in Southern England. The estimated rainfall change represents a substantial increase in the volume of water entering river catchments. It can therefore be regarded as a robust test of the extreme flood outline.

These extreme rainfall data were passed to the Environment Agency, allowing them to feed these into

their flood models and compute the likely flooding extent that would ensue. The results of these stress tests are presented in the NFRR report.

The Future

This new method, in which climate model simulations are used to explore the potential for meteorological ‘black swans’, is recognised as an innovative approach to estimating future environmental risks, such as heavy rainfall. These environmental risks are associated with weather and climate variability, as well as climate change.

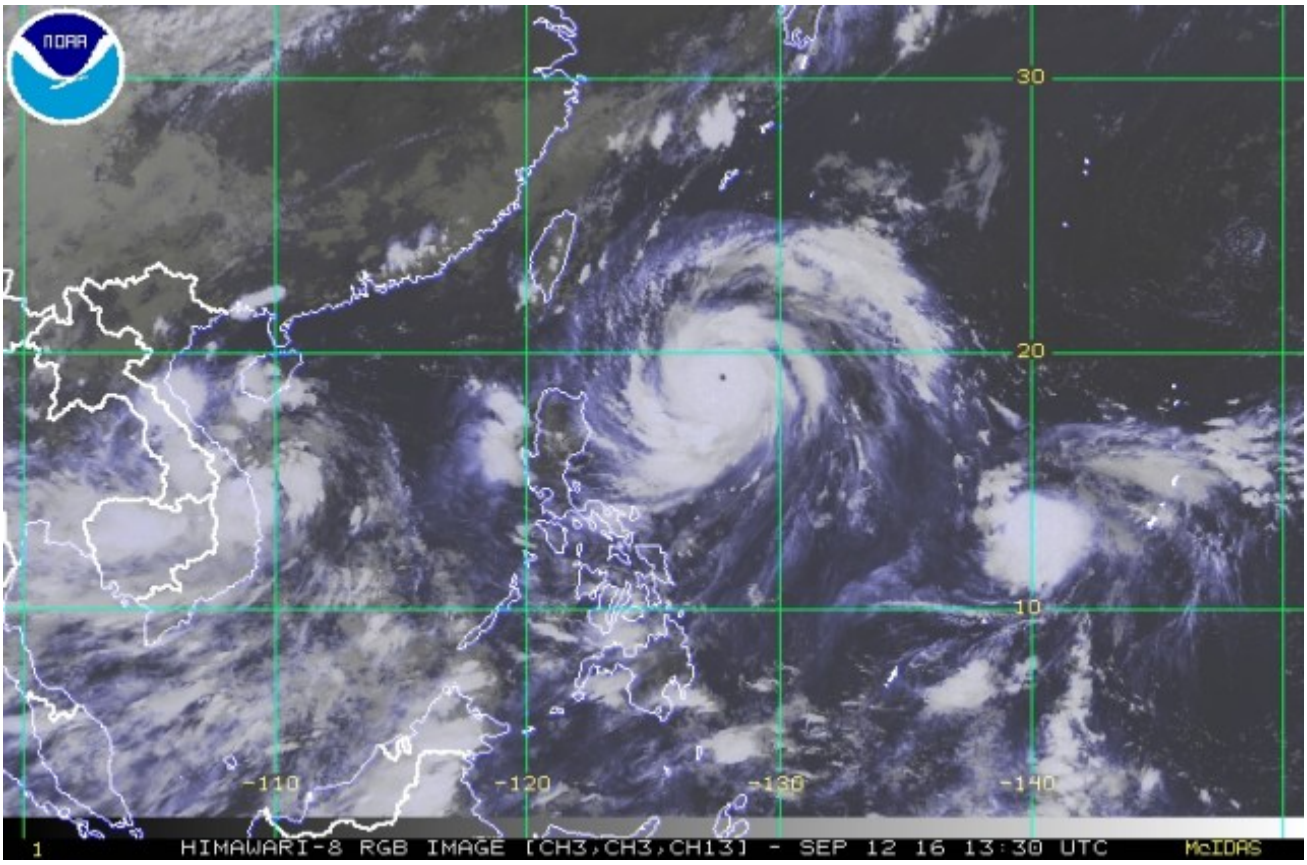
Plans are now being considered for the development of a more integrated flood risk modelling approach which would allow simulations to be run linking meteorology, hydrology and flooding. This would make it easier and quicker in future to assess the probability of given levels of flooding, helping identify impacts and evaluate flood management measures.

Date Created
September 2016

Typhoon Meranti threatens parts of Southeast Asia

Description

The western North Pacific has had a quieter than average typhoon season so far with only five tropical storms attaining typhoon status (winds of 74 mph or greater). However, the latest storm which formed over the weekend, named Meranti, has rapidly developed into an intense typhoon.



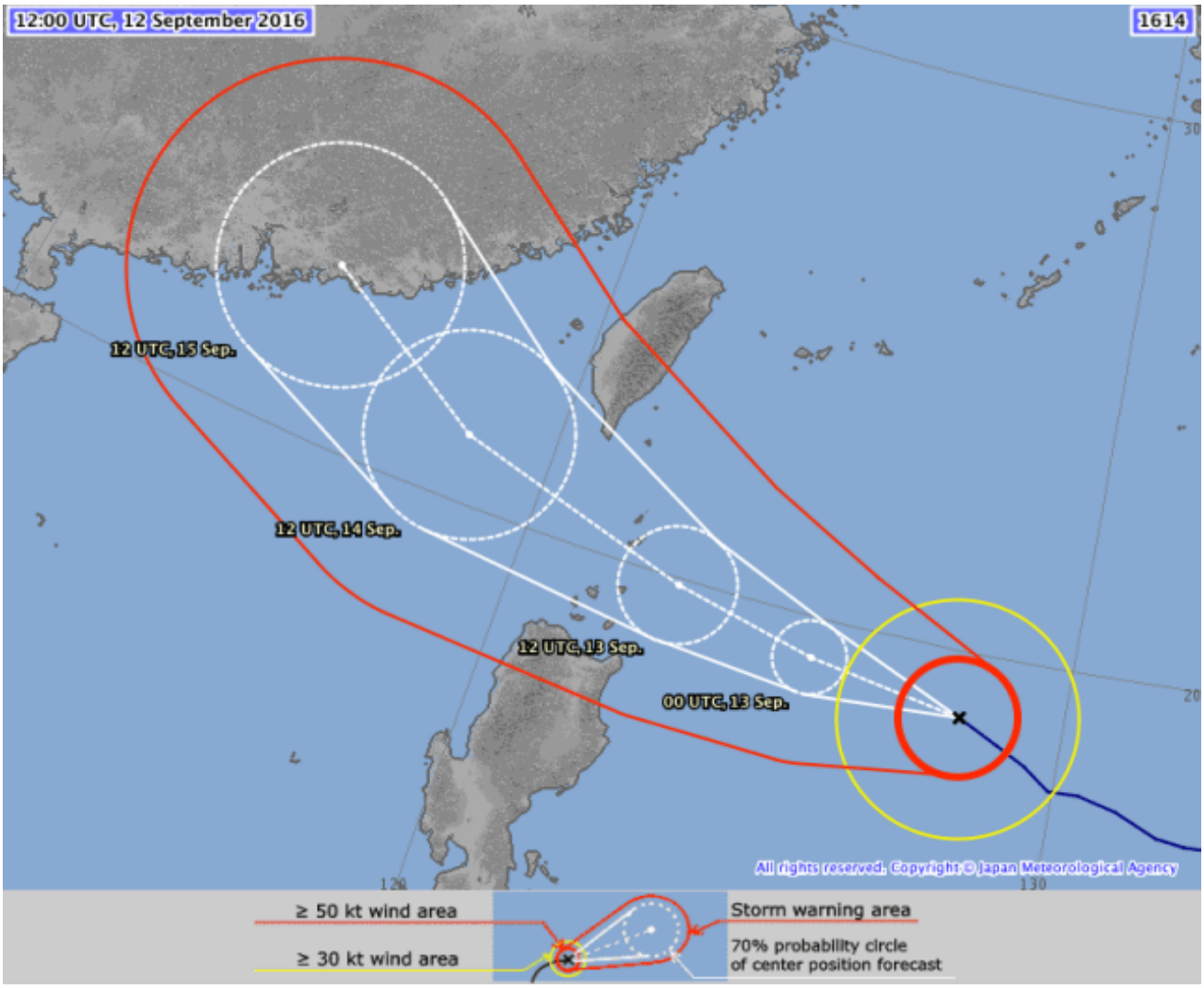
Typhoon Meranti in the western North Pacific on 12 September 2016 (credit: NOAA)

Meranti is currently located to the east of the Philippines and is moving west-north-west. Winds averaged over 1-minute are estimated to be near 180 mph making Meranti equivalent to a category 5 hurricane. Globally, it is just the fourth tropical cyclone to reached category 5 this year.

There is some uncertainty in the forecast track at present. The official warning agency for the region, the Japan Meteorological Agency, expects the centre of the typhoon to pass through the Luzon Strait between the Philippines and Taiwan as shown in the forecast chart. However, a slight shift north or south is possible which would bring Meranti closer to one of these two land masses. Even if Meranti follows the latest forecast, both Taiwan and the northern Philippines are likely to experience rain and wind from the periphery of the typhoon as it passes by.

After passing through the Luzon Strait Typhoon Meranti is expected to make landfall over China.

However, the uncertainty in the forecast at present means that a large portion of the coast should remain on alert including areas west of Hong Kong to areas adjacent to the Taiwan Strait.


12:00 UTC, 12 September 2016
1614
12 UTC, 15 Sep.
12 UTC, 14 Sep.
12 UTC, 13 Sep.
00 UTC, 13 Sep.
All rights reserved. Copyright © Japan Meteorological Agency
≥ 50 kt wind area
≥ 30 kt wind area
Storm warning area
70% probability circle
of center position forecast

Official forecast track for Typhoon Meranti from the Japan Meteorological Agency. The white dotted line is the most likely track of the centre of the typhoon.

Meranti is not the only west Pacific tropical system being watched at the moment. A tropical depression located to the east of Meranti is expected to strengthen and may also become a typhoon. This is likely to track a little further north than Meranti with areas under threat including northern Taiwan, the Ryukyu Islands and mainland Japan.

Official warnings for the latest tropical cyclones in the western North Pacific are produced by the Japan Meteorological Agency. The Met Office routinely supplies predictions of cyclone tracks from its global forecast model to regional meteorological centres worldwide, which are used along with guidance from other models in the production of forecasts and guidance. We also provide updates on current tropical storms via @metofficestorms on Twitter.

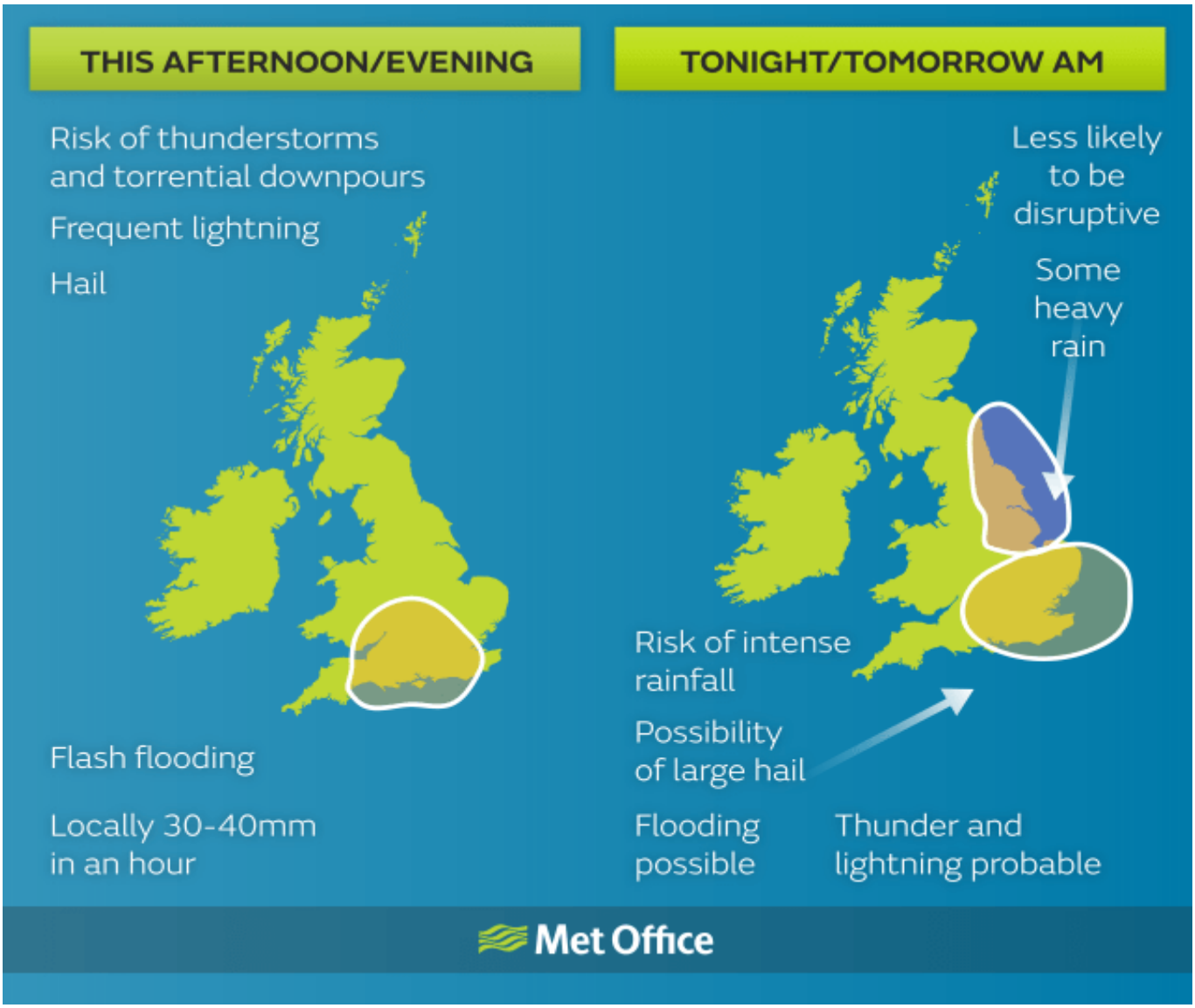
Date Created
September 2016

Thunderstorms bring an end to September heat

Description

If temperatures reach 30 ºC in the south east of England today (15 Sept 2016) it will be the first consecutive 3-day September period where temperatures reached over 30 ºC since 1929. However this is the last of the hot days as after today temperatures will be returning to what we would normally expect for this time of year.

The humid air currently in place over much of the UK is likely to lead to isolated, slow moving, severe thunderstorms later today, most likely over central southern England as daytime temperatures reach their peak. Into the evening and overnight a weather front moving in from the Atlantic will merge with the warm, unstable air over the country, resulting in a much larger area of heavy, locally thundery rain to develop over the eastern half of the UK. This will slowly clear eastwards during Friday.



Yellow severe weather warnings for rain are in force for both this afternoon and evening, and again for tomorrow. Some areas could see 30 to 40mm of rain in an hour and even, by Friday, up to 50mm in places, although the public should be aware that the vast majority of places will have less than this. If the heavier rain falls in built up areas or on main roads it has the potential to cause disruption to transport and possibly to power.

Earlier this week

The last week has seen some very warm weather. Temperatures on Tuesday peaked at 34.4 ºC in Gravesend in Kent, which was the hottest day of the year so far, as well as the hottest September day since 1911.

The day ended with severe thunderstorms in the Manchester area which disrupted traffic, delayed flights, led to some flooding and the Manchester City football game being cancelled.

What's to come

As the warm weather moves gradually away into the Continent temperatures are returning to what is more typical for this time of year. Eastern areas may remain cloudy over the weekend with outbreaks of mainly light rain as the remains of Friday's weather front lingers, but further west drier and sunnier weather will dominate. However, the influence of the Atlantic is likely to steadily increase, with the weather becoming more changeable overall into next week. The northwest is likely to see the worst of any wet and windy weather while the southeast is generally expected to be drier and brighter. Bands of rain are likely to move into the UK at times, interspersed with brighter drier spells, and showers.

You can keep up to date with the weather using our forecast pages and by following us on Twitter and Facebook, as well as using new mobile app which is available for iPhone from the App store and for Android from the Google Play store.

Date Created
September 2016

Record breaking September already beating summer months

Description

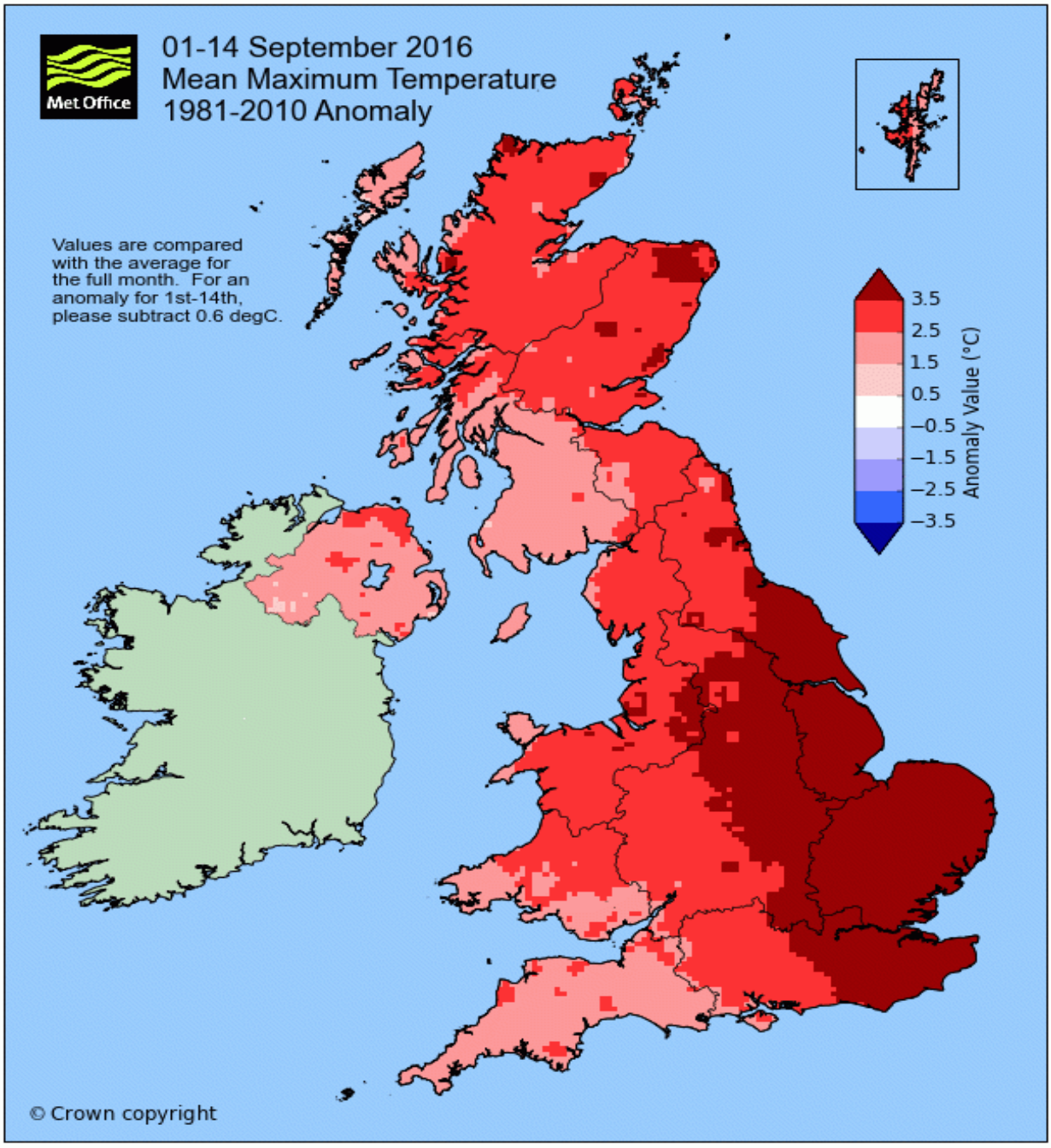
The provisional mid-month statistics for September are in and clearly show the unseasonably warm weather the UK has been experiencing.

In the first half of September the UK was on average warmer than June, July and August with a mean temperature of 15.9°C, 3.3°C higher than the average September. Norfolk and Suffolk have seen the biggest variance from the average with temperatures so far 4.3°C over the September average.

The hottest day of the year was recorded in Gravesend on 13 September at 34.4°C, the last time the hottest day was in the month of September was in 1954 and recorded at Regents Park. The last time there were three consecutive days above 30°C in September was 1929.

Minimum temperatures were also significantly higher than average. The minimum temperatures in North West England and Eastern Scotland were 3.8°C warmer than average.

These higher temperatures both through the day and night have been caused by warm and humid air being drawn up from the Continent. The map below clearly shows the increased average maximum temperatures across the UK in September so far.



Map showing 1-14 September 2016 mean maximum temperature anomaly from month average (1981-2010).

	Max temp (°C)		Min temp (°C)		Mean temp (°C)	
1-14 September 2016	**Act**	**Diff from avg (8110)**	**Act**	**Anom (8110)**	**Act**	**Anom (8110)**
UK	19.6	3.1	12.3	3.5	15.9	3.3
England	21.4	3.5	13.1	3.5	17.2	3.5
Wales	19.3	2.7	12.6	3.5	15.9	3.1
Scotland	17.0	2.7	11.0	3.5	14.0	3.1

N Ireland	18.3	2.2	11.8	3.2	15.0	2.6

Although unseasonably warm, there have also been some wet conditions across the UK. Northern Ireland has had 71% of its average rainfall for the month, with County Fermanagh already surpassing the expected average with 101.8mm of rain so far this month. Some of this rainfall has been intense causing some surface water flooding. The early hours of 16 September saw Swanage in Dorset receive 31.8 mm and Cavendish in Suffolk 22.2 mm of rain in an hour.

	Rainfall (mm)	
1-14 September 2016	**Act**	**% of avg (8110)**
UK	46.8	49
England	29.7	43
Wales	72.7	62
Scotland	65.1	48
N Ireland	65.0	71

> Intense #thunderstorms brought high rainfall totals overnight with Swanage recording 31.8 mm in an hour! pic.twitter.com/3lbpvDNOE9
>
> — Met Office (@metoffice) September 16, 2016

We are expecting a return to more usual September weather across the UK with temperatures reducing and frontal systems coming in from the Atlantic. We expect to see a continuation of the North West/South East split through the second half of the month, with the wettest and windiest conditions in the North West and drier and brighter weather in the South East with some rainfall as you would expect for the time of year.

You can keep up to date with the weather using our forecast pages and by following us onTwitter and Facebook, as well as using new mobile app which is available for iPhone from the App store and for Android from the Google Play store.

Date Created
September 2016

70th Anniversary of the LG Groves Memorial Awards

Description

The LG Groves Awards were set up in September 1946 in memory of Sergeant Louis Grimble Groves who died on 10 September 1945.

Before the modern technology or satellites that we use today, weather data needed to be collected in person. This often involved flying into extremely treacherous conditions as this was the only way of collecting accurate data. It was on a meteorological sortie like this that Sergeant Groves and eight other men lost their lives.

The data collected from these flights were used to plan military aeronautical deployments and were invaluable in managing the significant threat which the weather posed to our armed forces and the success of military operations. Throughout WWII there were a total of 18 squadrons and 750 men involved in 16,000 flying meteorological sorties. Sadly 52 of these aircraft never made it home.

Sergeant Groves' parents Major Keith and Dorothy Groves set up the LG Groves Awards with the aim of building a legacy and recognition of those working to improve aviation safety, hoping to prevent accidents such as the one in which their only son Louis died. To mark the 70th anniversary of the awards, a new memorial has been dedicated at the crash site as part of the 2016 LG Groves Awards ceremony.

Memorial for those who died in the Halifax MET MK III X9-N crash, of No 517 Squadron based at RAF Brawdy.

This year's Meteorological Observation Award went to Dave Sewell. Dave joined the Met Office as an Assistant Scientific Officer at RAF Boulmer in 1985 and now leads a team that observe and forecast quality. He is known for always looking to develop the less experienced forecasters to improve the standards in his area.

The Meteorology Award has been given to Nigel Roberts. Nigel is a leading expert in convective-scale modelling and predictability which is important for aviation forecasting and safety. The models Nigel has been working on have transformed the capability of forecasting systems used by the Met Office for regional predictions and local weather detail.

Attending the 70th anniversary awards ceremony Julia Slingo, Met Office Chief Scientist, noted "The LG Groves Awards serve as an important reminder of why we constantly strive to improve the relevance and reliability of our predictions of hazardous weather across timescales, in order to save lives and livelihoods, and the important role of observations in that endeavour".

Attendees at the 70th Anniversary of the LG Groves Awards.

The Met Office continues to work closely with the RAF , and also provides vital services to the commercial aviation sector.

More information on the LG Groves awards can be found online here: http://www.lggrovesawards.com/home.html

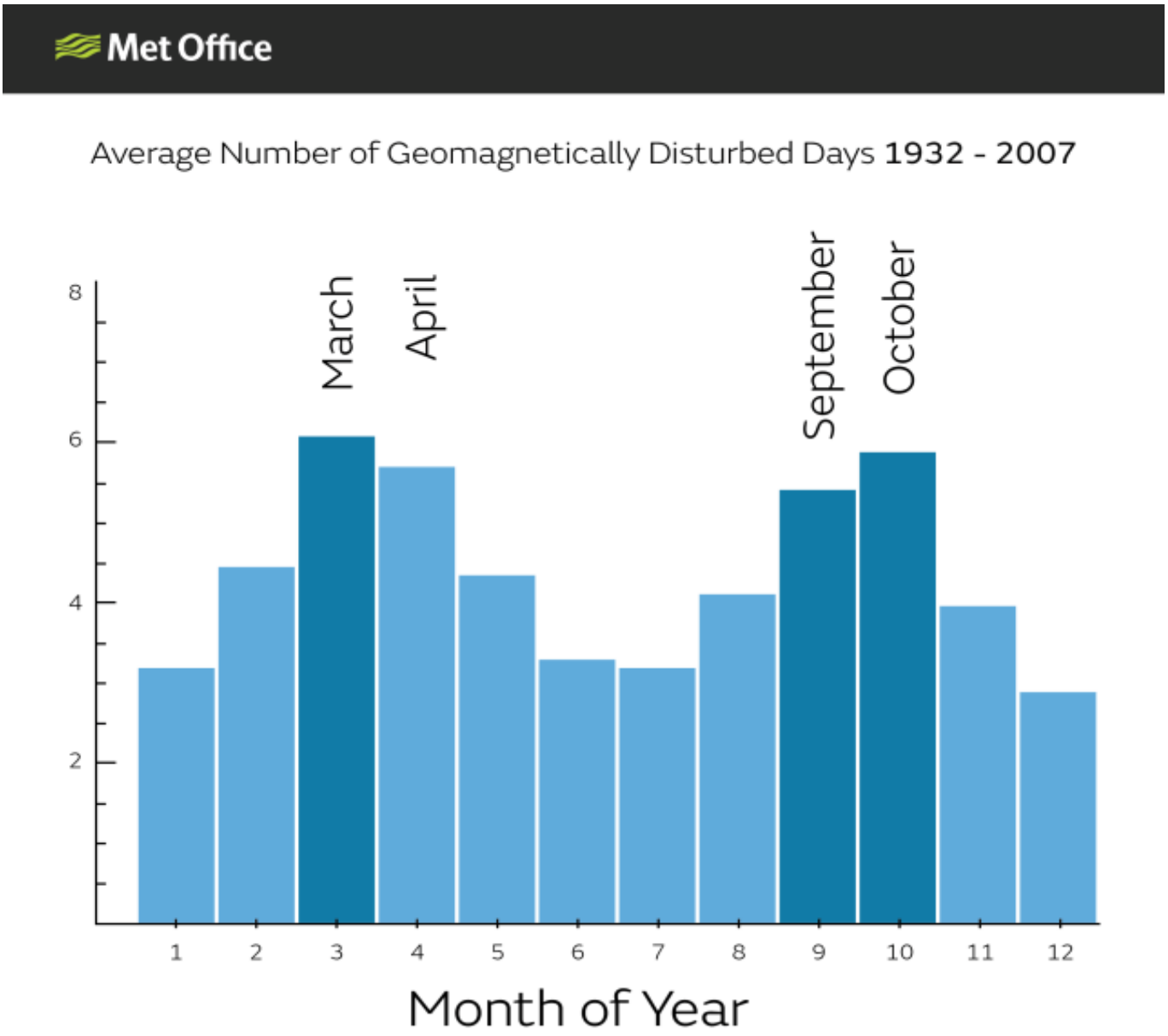
Date Created
September 2016

Keep your eyes peeled for aurora borealis

Description

Now we are in Autumn and the nights are getting longer the chances of seeing the Aurora borealis (or *Northern Lights*), particularly in the northern parts of the UK, is once again on the increase.

The science behind this is not fully understood, but the periods around the Spring and Autumn equinoxes tend to see an increase in the sightings of the aurora here in the UK compared with Winter and Summer.

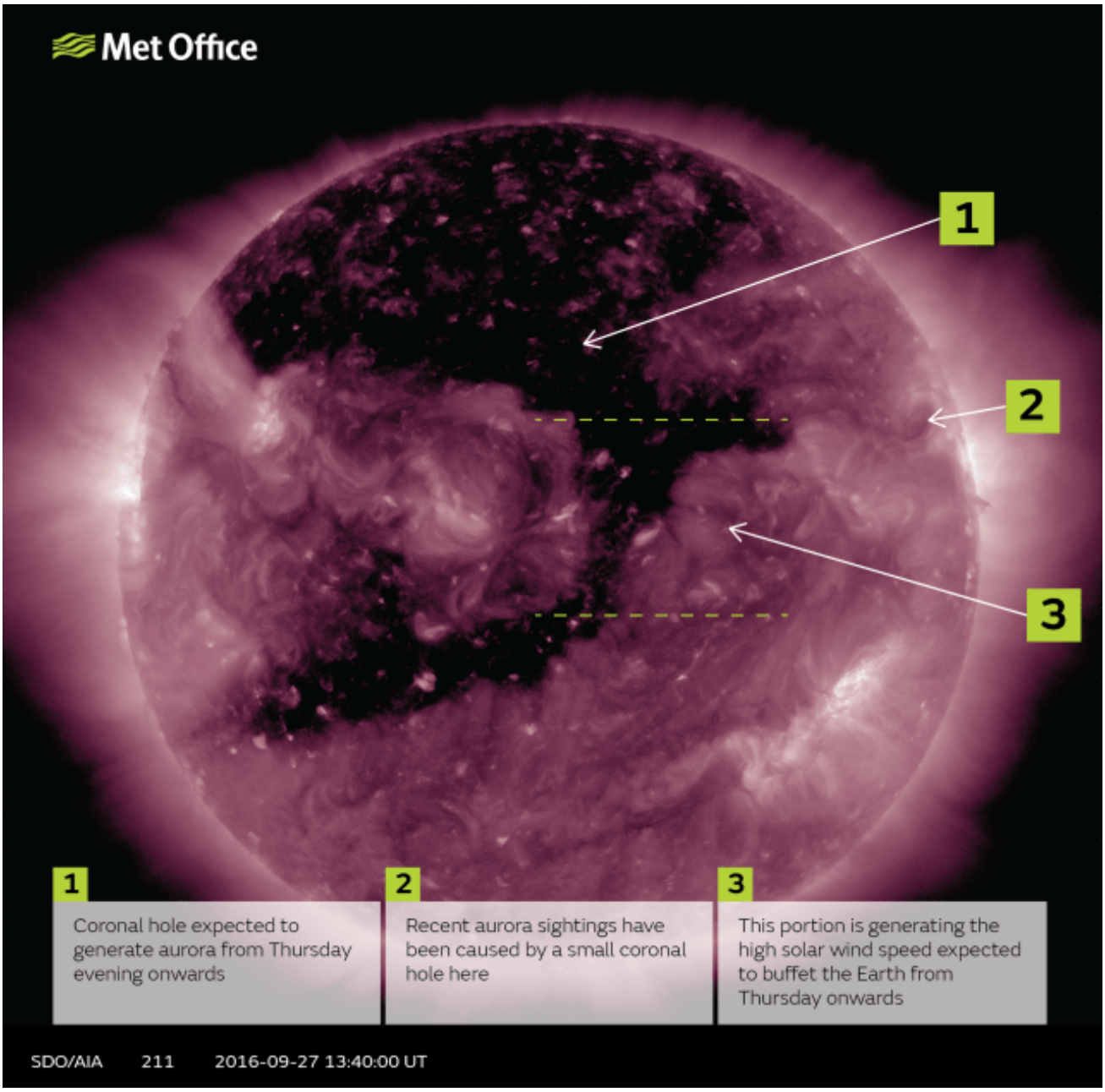


Why now?

There is an additional factor leading to an increase in the chance of seeing the Northern Lights at the moment.

The Sun goes through an 11 year solar cycle, from solar minimum, through solar maximum and backto solar minimum. We are now in the declining phase of the solar cycle following the solar max which occurred in early 2014. During the current phase of the solar cycle coronal holes that begin the cycle in the Sun's 'polar' regions have now migrated towards the Sun's equator, meaning they are on a similar line of latitude to the Earth (i.e. facing the planets rather than directed north and south out of the solar system). These coronal holes give rise to high speed solar wind streams that buffet the Earth, disturbing the Earth's magnetic field.

In other parts of the solar cycle these disturbances are largely as a result of coronal mass ejections, which can give larger magnitude disturbances than these high speed streams. The coronal hole expected to generate auroras later this week is the dark area indicated in the graphic below.


Met Office
1
2
3
1
Coronal hole expected to generate aurora from Thursday evening onwards
2
Recent aurora sightings have been caused by a small coronal hole here
3
This portion is generating the high solar wind speed expected to buffet the Earth from Thursday onwards
SDO/AIA 211 2016-09-27 13:40:00 UT
Graph courtesy NASA

The strength of the disturbance directly relates to how far south the *aurora* is visible (or how far north if you are in the southern hemisphere), and of course you need clear skies to see it.

Over the last few nights the Aurora borealis has been seen as far south as Northumberland and the chance of seeing the lights continues over the next few days if the weather conditions allow.

> And just got better #aurora #back of camera proper image later #Northumberland #bamburgh #northernlights pic.twitter.com/ffEIaJMd9t
>
> — Owen Humphreys (@owenhumphreys1) September 27, 2016

Assuming clear, dark skies, the aurora should be visible on the northern horizon from much of Scotland and Northern Ireland and possibly into northern England & Wales with the naked eye. Further south across the UK it may be possible to capture pictures of the aurora while facing the northern horizon with the use of long exposures on cameras.

Keep an eye on our space weather forecasts here and follow us on Twitter @MetOfficeSpace, if there's a chance of seeing the aurora in the UK we'll let you know.

The Met Office works closely with the British Geological Survey in Edinburgh to forecast these geomagnetic events and the BGS website provides to the minute information on the current activity levels as well as 'Tips on viewing the Aurora'. The BGS website includes a display of the aurora forecast model which is run by the NOAA Space Weather Prediction Centre, we are working on implementing this model at the Met Office.

Let's hope for clear skies and plenty of beautiful displays – if you are one of the lucky ones let the scientists know by tweeting about it on Geosocial aurora.

Date Created
September 2016

What’s happening around the globe

Description

People in some parts of the globe are anticipating the arrival of extreme weather.

Australia

Thousands of homes in South Australia are without power as an unusually deep area of low pressure moves across the area bringing gale force winds, rough seas and heavy rain. 50-100mm of rain is expected, which will fall as snow over the higher ground of the Australian Alpine region. The storm is being reported locally as potentially the “worst storm in 50 years”.

The impacts should start to ease by Friday, as the low pressure clears to the south east of Melbourne. But then conditions are due to intensify again as it crosses Tasmania later in the day, before clearing south over the weekend. Disruption to transport and power supplies in the area are likely.

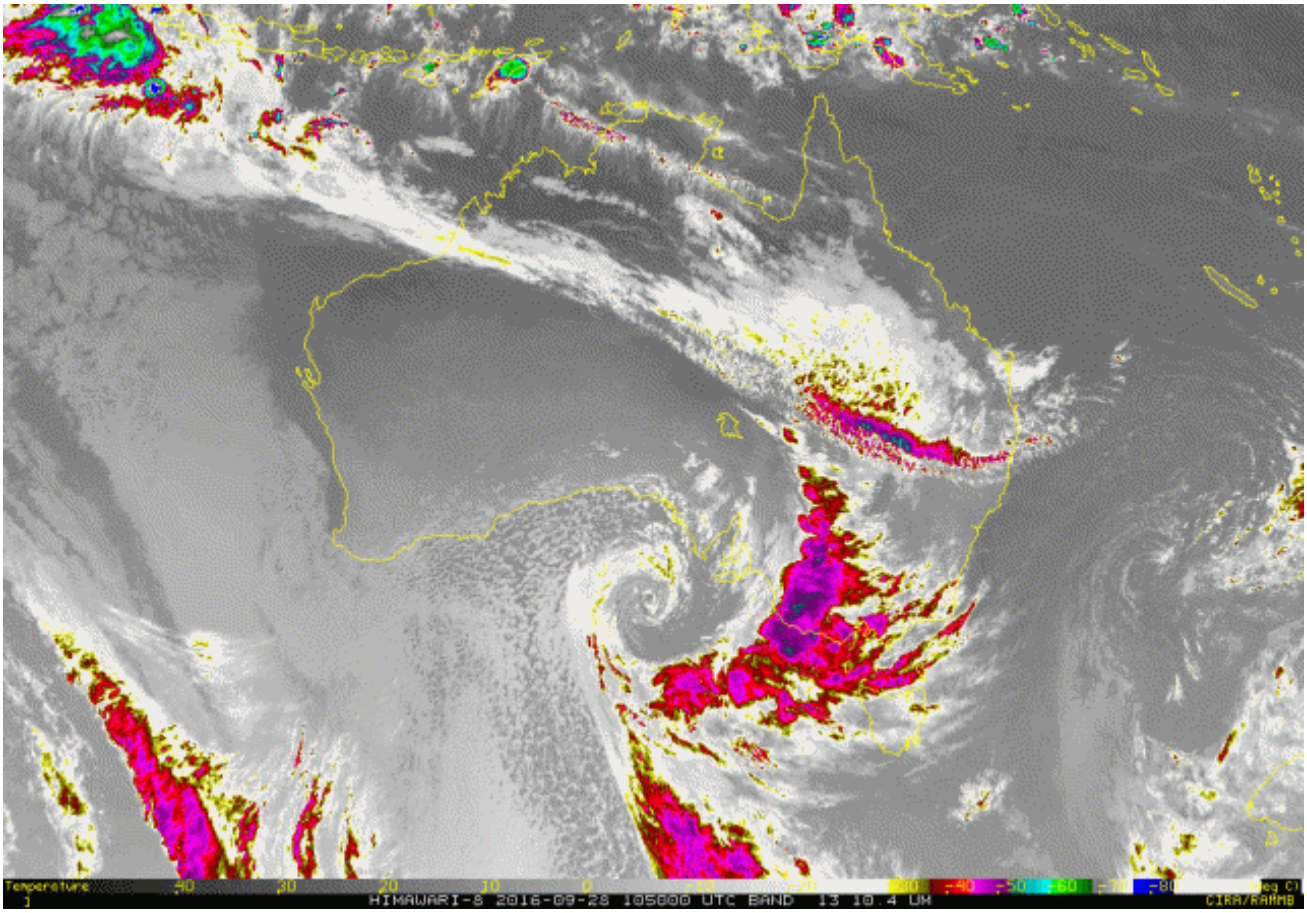


Image courtesy of NOAA Saatellites and Information

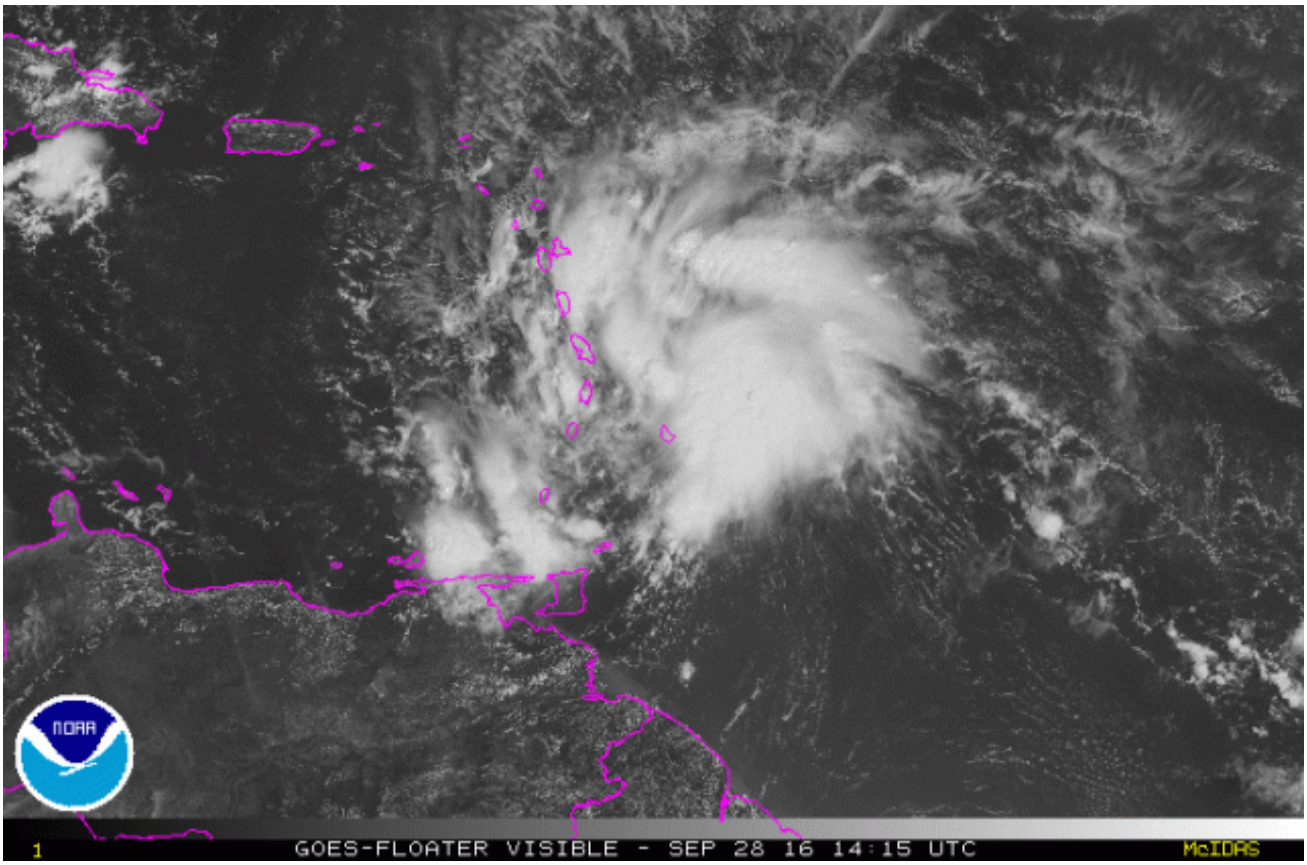
Tropical Cyclones in the Pacific and Atlantic

Typhoon Megi made landfall over Taiwan yesterday resulting in significant impacts from destructive winds and flooding. Taipei's Taoyuan International Airport reported tropical storm-force sustained winds for over 14 consecutive hours peaking at 99 mph. There was up to one metre of rain as the storm crossed the island and almost three million homes and businesses lost power.

The island's eastern coast was still recovering from damage caused by Typhoon Meranti earlier this month, followed by Typhoon Malakas. Megi then made a second landfall across southeast China, close to Putian, Central Fujian yesterday evening (UK time).

Megi was still a strong typhoon as it made landfall in southeast China yesterday evening, with gusts to 90 mph. Areas of the Fujian Province are expecting 300-500mm of rain locally, increasing the risk of flooding, landslides, and disruption to transport and power supplies.

Meanwhile a tropical disturbance to the east of Barbados has just been upgraded to a tropical storm named Matthew.



Picture courtesy of NOAA

Matthew has the potential to bring significant rainfall to the Windward Islands today, before moving across the south-eastern Caribbean Sea on Thursday. Heavy rains (100-200mm) and tropical storm-force winds are expected to bring a risk of flash flooding, damaging winds, rough seas and mudslides to the Windward and southern Leeward Islands.

Latest predictions suggest that Matthew could become a hurricane and make a sharp turn northwards early next week. This would bring a possible threat to countries such as Jamaica, Haiti and Cuba.

However there remains much uncertainty at this time for the evolution, track and intensity of this storm beyond the weekend.

Date Created
September 2016

September warmth in the UK

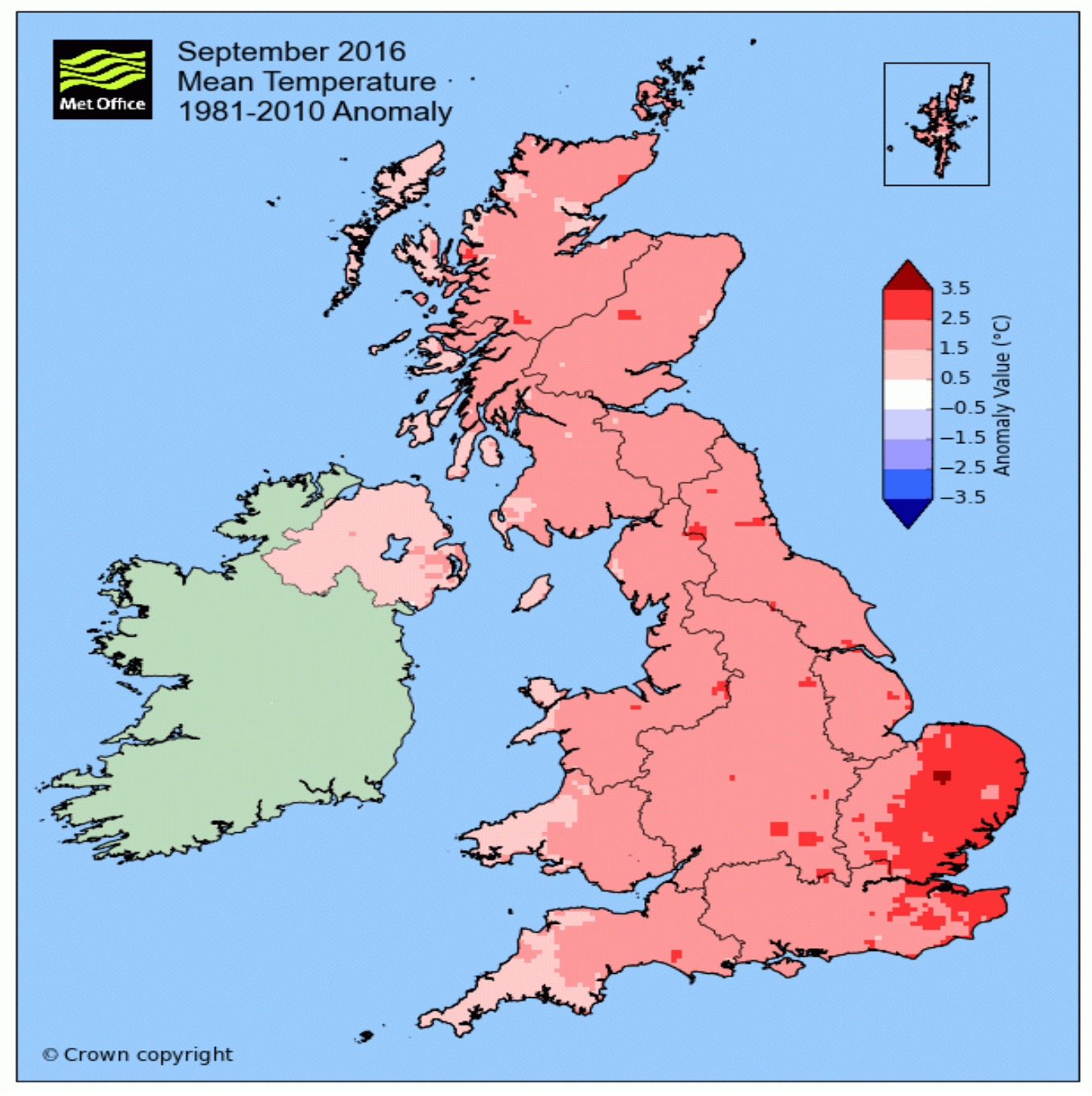
Description

Figures and text updated 4 October 2016 with provisional full month data.

Despite a mixture of weather across the UK, two warm spells around the 9th and 13th of the month helped boost temperatures, with this September provisionally the equal-second warmest for the UK since records began in 1910. Provisional stats show the mean temperature for September to be 14.6C tied with 1949 but behind 2006 (15.2C).

The first month of autumn started on an unsettled note, but then a southerly airflow bringing warm air from the continent allowed temperatures to climb. This led to the warmest day of the year on the 13th when 34.4C was recorded at Gravesend in Kent. It’s quite unusual to see temperatures this high so late in the year. The *last* time the hottest day of the year was recorded in September was in 1954 with 30.0C recorded at Regents Park, London on the first day of the month. However, we have to go back to 1926 to find the last time the warmest day of the year occurred this late in the year (31.7C Hunstanton, Norfolk on 19 September).

The image below shows that mean temperatures were 1.5-2.5C above the 30-year average across many parts of the UK, but that eastern parts were almost 3C above average. Sunshine hours echoed this pattern with amounts above average in eastern parts. Skies were cloudier in the west, but sunshine hours were still not far off average.



September 2016 Provisional	Maximum temperature		Minimum temperature		Mean temperature	
	Actual deg C	Anm	Actual deg C	Anm	Actual deg C	Anm
UK	18.3	1.8	11.0	2.2	14.6	2.0
England	19.8	2.0	11.9	2.4	15.9	2.2
Wales	18.0	1.4	11.2	2.0	14.6	1.7
Scotland	16.0	1.7	9.5	2.0	12.7	1.8
N Ireland	17.0	0.9	10.1	1.5	13.6	1.2

The heat did trigger some spectacular thunderstorms and there were spells of rain both early and late

in the month with some western areas exceeding their monthly average. However, some areas were much drier, particularly in the east of Scotland and southeast England. Overall, provisional rainfall figures for the month are close to average with 98.9mm recorded compared to the September average of 96.4mm.

September 2016 Provisional	Sunshine hours		Rainfall	
	Actual hours	Anm %	Actual mm	Anm %
UK	118.5	95	98.9	103
England	134.8	98	63.6	91
Wales	115.8	91	145.3	125
Scotland	96.3	92	144.0	106
N Ireland	94.8	84	104.2	114

Date Created
September 2016